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A LOOK AT THE PROTEIN SITUATION FOR LIVESTOCK

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This report brings up to date a processed report of the Bureau of Agricultural Economics published in April 1946 called "The Deficit in Protein for Livestock".

A LOOK AT THE PROTEIN SITUATION FOR LIVESTOCK

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INTRODUCTION

Much less protein is fed to livestock in this country than is needed for balanced nutrition. More high-protein feeds are fed per animal now than before the war. Not enough protein is produced here to satisfy the nutritional needs of each kind of livestock. We have a plentiful supply of carbohydrate feeds at the present time, but not enough high-protein feeds to raise the protein content of the livestock ration generally to a level that is considered adequate by animal husbandmen and farmers.

The number of livestock is now expanding without a proportionate increase in high-protein feeds (fig 1). In the last year or two the prices of animal protein feeds have been high and at times the prices of some of the oil meals also have been relatively high. It is, therefore, worth while to take a look at the protein situation to see where we stand.

METHOD OF PROCEDURE

If we should use the recommended levels of protein content of the ration as given in feeding standards for each kind of livestock we would be far short of the protein needed. Preparatory to taking this look we computed for each year since 1937 the percentage of digestible protein needed in all concentrates for all livestock combined and compared this with the protein in the concentrates believed to have been fed (table 1). This calculation shows that in any recent year enough protein for this purpose would have required around 6 million tons of additional soybean meal or its equivalent. This is about double the total output of oilseed meals in any recent year. This estimate may be low as it does not allow for the over-feeding of protein that normally takes place such as feeding more cottonseed meal by some farmers in the South than is necessary from the standpoint of maintaining the protein balance.

Table 1.- Deficit in protein for all livestock, using requirements given in feeding standards as the quantity needed, 1937-49

Feeding year beginning October 1	Concentrates fed 1/	Percentage digestible protein needed	Total digestible protein needed	Digestible protein fed	Deficit in digestible protein	Deficit expressed in soybean meal equivalent
	Thousand tons	Percent	Thousand tons	Thousand tons	Thousand tons	Thousand tons
1937	95,090	11.56	10,992	9,825	1,167	3,334
1938	97,146	11.60	11,269	9,765	1,504	4,297
1939	100,418	11.60	11,648	10,036	1,612	4,606
1940	106,108	11.68	12,393	10,722	1,671	4,774
1941	116,408	11.72	13,643	11,610	2,033	5,808
1942	140,284	11.66	16,357	14,027	2,330	6,657
1943	136,995	11.75	16,097	13,827	2,270	6,485
1944	126,125	11.84	14,933	12,741	2,192	6,263
1945	130,427	11.79	15,377	12,841	2,536	7,246
1946	120,599	11.85	14,291	11,981	2,310	6,000
1947	108,245	11.89	12,870	11,117	1,753	5,008
1948	120,280	11.91	14,325	12,184	2,141	6,117
1949	124,693	11.90	14,838	12,499	2,339	6,682

1/ All grain (excluding corn in silage) and byproduct feeds including seeds and skimmilk fed.

The method of computing the "percentage of digestible protein needed" shown in column 2 of table 1 is given in more detail in the report, "The Deficit in Protein for Livestock," (Processed report, issued by BAE, April 1946). The recommendations are summarized briefly in the following paragraph.

The percentage of crude protein in the concentrate ration recommended by dairy husbandmen for dairy cows was varied by regions depending largely on the kind of hay available in the region, length of pasture season, etc., it averaged about 16 percent for the country as a whole. 1/ The recommended level was 15 percent for laying flocks, 18 percent for growing chickens, 20 percent for broilers, and 19 percent for turkeys. This averaged about 16.4 percent for all poultry. A level of 14 and 15 percent was recommended for hogs the lower figure being used for most of the Middle West where pasture is generally available. The protein requirements for dairy heifers, beef cattle, and sheep, were computed on the basis of Morrison's recommendations in Feeds and Feeding. 2/ For all livestock combined the crude protein required comes to about 14.9 pounds (11.9 pounds digestible protein) per 100 pounds of grain and other concentrates fed. This figure has been gradually increasing over the years as the number of horses and mules has been decreasing. Horses and mules require less protein in relation to grain fed than do other kinds of livestock.

IMPORTANCE OF PROTEIN

Protein is an important constituent of all livestock products. It makes up the following percentages of the dry matter of leading animal products: 36 percent of a Good grade beef carcass, 27 percent of a Medium grade hog carcass, 60 percent of a chicken, 49 percent of an egg, and 27 percent of milk. On a comparable basis dry beans have a content of about 24 percent of protein and wheat flour about 13 or 14 percent. Foods of animal origin are high in protein compared with foods of plant origin. Enormous quantities of protein of both animal and plant origins are eaten by livestock to supply the protein in the meat, eggs, and milk used for food in this country. Young growing animals are fed proportionately larger quantities of protein than mature animals or poultry or those being fattened.

When a ration is fed that contains much less protein than is needed its efficiency is lowered. In other words, it takes more pounds of grain to make the same gain in weight if too little protein is fed.

1/ In the 1949 annual report of the Chief of the Bureau of Dairy Industry a report of recent experimental work indicates that less protein is required for dairy cows than was formerly recommended. It appears safe to recommend rations containing 3 to 4 percent less protein with grain mixtures than was previously recommended for average farm cows. This means for example that a ration containing 15 percent protein can be used instead of one containing 18 percent. Such a change would result in a reduction of 17 percent in the calculated protein requirements.

2/ Morrison, F. B., Feeds and Feeding. A Handbook for the Student and Stockman, Edition 21, 1207 pp. Ithaca, New York 1949. See table 3.

In the case of mature animals, the protein requirements for repair of and addition to body tissues are small. If only this quantity were fed it would be too small from the standpoint of digestibility of the ration. The bacteria in the digestive tract, in order to do their work most effectively, seem to require a certain balance between protein and the easily digested carbohydrates such as grain.

Corn is the principal feed for hogs. It contains protein but not enough, nor the right kind, for a balanced ration. When pigs weighing 69 pounds were fed only on corn they gained only 72 pounds in 4 months and used 642 pounds of corn to make 100 pounds of gain. 3/ Other pigs that were fed corn and tankage made twice as much gain in the same time and used only 387 pounds of corn and 42 pounds of tankage per 100 pounds of gain. This, of course, is an extreme example since probably a relatively small percentage of farmers today feed only corn. But, if this experiment had started with weanling pigs the results would have been even more striking, for the requirements are much heavier in the early stages of growth than later on.

In regard to feeding protein to beef cattle Morrison makes this statement (Feeds and Feeding 21st Ed. p. 779). "It is believed, however, that if the protein supply is reduced much (below standard) the gains are apt to be lessened, and more feed required per 100 pounds gain. Also there will be a tendency for the cattle to sell at a lower price because of less satisfactory finish." He states with regard to a protein-poor ration for fattening cattle, "When care is taken to feed no more protein supplement than is actually needed to balance the ration each 100 pounds of such a supplement as linseed meal, soybean oil meal or cottonseed meal will be equal in value to 250 to 300 pounds of grain or grain equivalent."

The economic importance of sufficient protein then is that it reduces the quantity of grain and other feeds required to make the meat, eggs, and milk, that the farmers produce. To figure out how much it would mean to a farmer to feed a ration containing 15 percent protein to his hogs, chickens, or cows, (instead of 12 percent) is a job in itself, and not to be undertaken here. The kinds of hay, pasture, and grain, that are available must be taken into account. The prices of feeds and of the products must also be considered. If the additional protein needed to balance the ration costs so much that the combination of the feed saved and the additional product produced would not pay for it, then it would not be profitable for the farmer to increase the protein content of the ration. Under conditions of favorable prices, such as we have had in recent years, there is no doubt but that much more high-protein feeds would have been fed at prevailing prices if they had been available. Although it might not be economical to feed all of our livestock as much protein as is called for by the feeding standards, there is no doubt that it would pay to feed the herds and flocks on commercial farms a better balanced ration than they are now receiving.

SOURCES AND SUPPLY

Protein for livestock feed comes from several sources. About 23 percent of the total protein consumed by livestock comes from grains fed, 10 percent from the commercial high-protein byproduct feeds, 6 percent from other byproduct feeds, 26 percent from hay, silage, and stover, and

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3/ Morrison, Feeds and Feeding, p. 480. See also Ohio State Agricultural College Extension Service Bul. 203, tables 40 to 50.

35 percent from pastures. These figures are only approximate as it is impossible to estimate closely the quantity that comes from pasture and hay. Pasture is the most important single source of protein. Young grass has as much protein on a dry-matter basis as some mill feeds and other concentrates, but the protein content of grasses usually decreases as the season advances, and in a few weeks the grasses may contain only half as much protein as in the early weeks.

Hay is a valuable source of protein, but the protein content of different kinds of hay varies widely. Alfalfa hay contains about 10 percent of digestible protein, mixed clover and timothy about 5 percent and many of the wild hays less than 3 percent. It is estimated by the writer that the average of all hay is about 6.7 percent. The average protein content of hay is no larger and perhaps is smaller than before the war, because an increase in the production of alfalfa has been offset by a decrease in the production of soybean hay and an increase in the hays of a relatively low protein content, as lespedeza and mixed hay. The protein content of hay is affected to some extent by the stage at which it is cut, by the method of curing, by the degree of fertilization of the soil, and by the application of nitrogenous fertilizers. The present interest by farmers in improved hay-making practices may result in some increase in protein for hay-consuming livestock.

About one-fourth or one-fifth of the total quantity of protein fed comes from corn, oats, and the other grains. Corn alone accounts for more than half of the protein in grains. An influential development has been the large increase in production of hybrid corn, which has only 6.5 percent digestible protein compared with 7 percent in open-pollinated varieties. 4/ This means that it takes more than a million more tons of oil meal to offset the lower protein content of hybrid corn, compared with the use of open-pollinated varieties before the war for a crop of the same size. This is about one-seventh of the oil meal produced annually in the last year or two.

The oil meals and other commercial high-protein feeds account for about 10 percent of the total protein supply and about one-fourth of the quantity in all concentrate feeds. High-protein feeds are of great importance, however, since they are used by feed manufacturers and farmers to mix with grains, mill feeds, etc., to raise the average protein content of the ration. The oil meals comprise nearly three-fourths of the tonnage of commercial high-protein feeds, and soybean cake and meal have accounted for most of the 87 percent increase in oil meals in the last 2 years as compared with prewar conditions (table 2).

Gluten feed and meal, brewers' dried grains, and distillers' dried grains, account for 15 percent of the total commercial high-protein feeds used in recent years. They have each increased as compared with prewar,

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4/ Morrison, F. B., Feeds and Feeding, table 1.

Table 2.- Estimated use of high-protein feeds for feed, year beginning October 1, average 1937-41, annual 1944-49 1/

Item	Average 1937-41	1944	1945	1946	1947	1948 2/	1949 3/
	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons	1,000 tons
Oilseed cake and meal							
Soybean cake and meal	1,258	3,627	3,655	3,745	3,383	4,137	4,200
Cottonseed cake and meal	1,958	1,982	1,433	1,434	1,954	2,271	2,350
Linseed cake and meal	481	459	563	370	605	620	600
Peanut cake and meal	75	96	83	88	105	73	75
Copra cake and meal	134	42	69	190	177	161	175
Total	3,906	6,206	5,803	5,827	6,224	7,262	7,400
Animal proteins							
Tankage and meat scraps	728	792	745	741	824	850	900
Fish meal	235	209	194	191	212	220	235
Commercial dried-milk products	139	105	100	115	90	95	115
Noncommercial milk products 4/	1,829	1,465	1,360	1,300	1,265	1,300	1,350
Total	2,931	2,571	2,399	2,347	2,391	2,465	2,600
Grain protein feeds							
Gluten feed and meal	690	864	802	1,040	799	848	850
Brewers' dried grains	119	217	213	229	228	230	225
Distillers' dried grains	203	634	326	410	353	325	300
Total	1,012	1,715	1,341	1,679	1,380	1,403	1,375
Total high-protein feeds	7,849	10,492	9,543	9,853	9,995	11,130	11,375

1/ Derived as follows: Production plus imports; minus exports and utilization for food and industrial products; and adjusted for change in stocks of feed for which data on stocks are available.

2/ Preliminary.

3/ For 1949-50, tentative estimates based on indications in January.

4/ Dry equivalent of skimmilk, buttermilk, and whey, fed as a liquid.

and as a group are about 40 percent larger in tonnage than then. The commercial animal protein feeds, as a group, comprise only about 12 percent of the tonnage of commercial high-protein feeds and have not increased much in tonnage, compared with prewar. Fish meal and commercial dried-milk products are lower than prewar, whereas tankage and meat scrap are 15 to 20 percent larger. The dry equivalent of skimmilk fed as a liquid is larger than that of all other animal protein feeds combined, but is more than one-fourth less than prewar, largely because a higher percentage of all milk is being consumed as whole milk now than before the war.

The supply of high-protein feeds for the current feeding year (1949-50) is not only high in tonnage compared with past years (table 2) but is high in comparison with the livestock to be fed (table 3). There are 143 pounds of high-protein feeds per animal unit of all livestock except horses and mules. This is less than in 1948-49 but higher than in all other years. The supply of oil meals per animal unit is 93 pounds. The supply of animal proteins per animal unit is not much different from what it has been for several years and is considerably below prewar. The production of tankage and meat scrap varies with the number of livestock slaughtered. The supply of high-protein feeds in 1949-50 is also high relative to the total concentrates to be fed, amounting to 9.6 percent of the total. Only in the 2 preceding years was it a little higher. Thus, from a historical standpoint the quantity of high-protein feeds is relatively abundant.

Supply per animal unit does not tell the whole story, however, for livestock production per animal is considerably above the prewar average. Milk per cow, eggs per hen , and the average weight of hogs, for several years have been higher than before. This means more proteins and other feeds fed per animal because of greater production per animal.

The average price of oil meals in 1949 was 219 percent of the 1935-39 average, while prices of feed grain were 175 percent of their 5-year average and prices of livestock were 238 percent of their average (table 4). Prices of oil-seed meals were thus relatively lower than livestock prices but were above feed-grain prices, compared with prewar. They were 15 to 20 percent lower in price in 1949 than in 1947 and 1948. Thus, the average price of oil meals in 1949 was not especially high in relation to livestock prices.

On the other hand, the price of animal protein feeds in 1949 averaged 328 percent of prewar and 15 to 20 percent above 1947 and 1948. Prices of animal proteins were 50 percent higher than oil-seed meals in 1949, thus reflecting the short supply compared with oil meals and the strong demand for these feeds for poultry and hog rations.

Table 3.- Consumption of high-protein feeds in relation to livestock and feed concentrates fed

Feeding season beginning October 1	Protein feeds					Animal units of grain-consuming livestock		Consumption of protein feeds				
			Animal protein					Per animal unit				Protein feeds as a percentage of all concentrates fed to all livestock except horses and mules
	Oilseed meal (1)	Grain protein feeds (2)	Excluding skimmilk fed as a liquid (3)	Including skimmilk fed as a liquid (4)	Total including skimmilk fed as a liquid (5)	Total except horses & mules (6)	Poultry and hogs (7)	Col. 1 divided by Col. 6	Col.3 divided by Col.7	Col.4 divided by Col.7	Col.5 divided by Col.6	
	Thous. tons	Thous. tons	Thous. tons	Thous. tons	Thous. tons	Million units	Million units	Pounds	Pounds	Pounds	Pounds	Percent
1937-41 av.	3,906	1,012	1,102	2,931	7,849	136.1	92.7	57.4	23.8	63.2	115.3	8.6
1942	6,088	1,513	1,174	2,884	10,485	176.7	127.8	68.9	18.4	45.1	118.7	8.1
1943	6,255	1,517	1,271	2,816	10,588	178.0	127.8	70.3	19.9	44.1	118.9	8.4
1944	6,206	1,715	1,106	2,571	10,492	159.1	109.1	78.0	20.3	47.1	131.9	9.0
1945	5,803	1,341	1,039	2,399	9,543	154.2	106.2	75.3	19.6	45.2	123.8	7.9
1946	5,827	1,679	1,047	2,347	9,853	148.9	101.5	78.3	20.6	46.2	132.3	8.8
1947	6,224	1,380	1,126	2,391	9,995	144.0	99.6	86.4	22.6	48.0	138.8	9.8
1948	7,262	1,403	1,165	2,465	11,130	150.8	106.2	96.3	21.9	46.4	147.6	10.0
1949	7,400	1,400	1,250	2,600	11,400	158.9	113.2	93.1	22.1	45.9	143.4	9.6

Table 4.- Index numbers of prices of feeds and livestock, 1945 to 1949

(1935-39 = 100)

Year	Feed grains	Oilseed meals	Animal protein	Livestock and livestock products
1945	168	166	166	174
1946	211	229	208	206
1947	274	266	288	251
1948	273	266	279	274
1949	175	219	328	238

USE OF HIGH-PROTEIN FEEDS IN COMMERCIAL MIXED FEED

A significant change in the situation, compared with prewar, is the great increase in the use of commercial mixed feeds, especially poultry feeds. The Bureau of the Census reported that 22 million tons of poultry and livestock feeds were manufactured in 1947. In 1939 only 13 million tons of prepared feeds were reported. The feed-mixing industry had about twice as many establishments and more than 2 1/2 times as many production workers in 1947 as in 1939. The 22 million tons manufactured in 1947 accounted for nearly one-fifth of the total concentrates fed to all livestock in this country. The 11.7 million tons of poultry feeds manufactured in 1947 were more than 40 percent of all feed fed to poultry.

The 1947 Census shows the materials going into mixed feed. From this it was estimated by the writer that nearly all of the fish meal and scrap and dried milk and more than 90 percent of the tankage and meat scrap produced goes into mixed feed. The percentages for other kinds of feed were: gluten feed and meal and brewers' and distillers' grains, 80 to 85 percent; soybean meal 70 to 75 percent; linseed meal 40 to 50 percent; cottonseed meal 15 to 20 percent. Fifty-five percent of all oil meal probably has gone into mixed feed and 65 percent of all high-protein concentrates. It was estimated that 40 to 45 percent of all the high-protein feeds used in the mixed-feed industry, in 1947, went into poultry feeds and 35 to 40 percent into dairy feeds. As the mixed-feed industry uses a large part of the output of high-protein feeds it is easy to understand why, during periods of general shortages, there have been times when it was difficult for farmers to obtain high-protein meals and other primary ingredients.

WHAT CAN BE DONE ABOUT THE PROTEIN SHORTAGE

Dairy cattle and poultry come nearest to obtaining the protein needed for balanced nutrition. The lack of protein balance is probably greatest with respect to hogs. In any case, a large increase in the output of high-protein concentrates would be necessary to balance all livestock rations. Information at hand does not indicate that we are likely to attain this output in the foreseeable future. A principal reason is that most of the high-protein concentrates are secondary products or byproducts from other production processes. They are not produced primarily for protein feeds. Hence changes in the demand for high-protein feeds have relatively little influence on the production of such feeds. The future supply of high-protein concentrates will depend largely on the demand for the primary products of the inductries involving cotton, fats, and oils, meat packing, fish canning, manufacture of corn products, and brewing and distilling.

The outlook for soybeans is relatively more favorable than most other oil seeds. A bushel of soybeans makes about 9 pounds of oil and 48 pounds of meal. The 1937-41 average value of 9 pounds of oil at 6.4 cents per pound and 48 pounds of meal at $30.74 a ton meant a wholesale value of $1.31 for the products from a bushel of beans. The average farm price of beans was 96 cents a bushel or about three-fourths as much as the wholesale value of the product. With oil at, say, 10 cents a pound, and meal at $60 a ton the total value product from a bushel of beans would be $2.34. Seventy-five percent of this is $1.76, or the price that might be paid for a bushel of soybeans under these assumptions. Under such conditions soybean meal would be the main product and oil the byproduct.

One of the outstanding developments in livestock feeding over the past 20 years has been the expansion in the consumption of oil meals per animal unit without much of any change in the price of such feeds relative to feed prices in general. The consumption of oilseed meals per animal unit in the 3 years, 1947-49, was more than 60 percent above the 1937-41 average, at prices not much different relatively than prices of feed grains or livestock. This seems to represent a real increase in demand; apparently the wartime increase in demand has carried over into peacetime. Probably high prices for livestock and the growth in the mixed-feed industry were the most important influences in this respect. This increase in demand may not continue at as fast a rate especially if livestock prices decline.

Improvement in Hay and Pasture

There is no apparent prospect of increasing the supply of high-protein feeds enough to offset fully the protein deficiency. Some opportunity for correcting this deficiency seems to lie in the direction of the improvement of hay and pasture. Higher protein content of hay and pasture would permit much high-protein feed that is now fed to dairy cattle to be shifted to hogs and poultry. An estimate was made for 1941-42 5/ of the effect of an assumed increase in the production and

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5/ See reference on back of cover page.

quality of legume hay on the protein available for cattle and sheep. It assumed (1) a substantial shift from non-legumes to legumes in all regions except the South and West, (2) a large increase in hay production in the south, (3) an increase in the protein content of the hay through improved harvesting practices. These assumed changes would produce enough additional protein to more than take the place of all high-protein feeds consumed by dairy cattle, beef cattle, and sheep. These assumptions of course, greatly exaggerate immediate prospects, but if the quantity of protein in all hay fed to dairy cattle in 1947-48 were increased only 5 percent through more hay, or better hay, it would represent either more protein for dairy cattle or release of about 500,000 tons of oil meal that could be used to increase the quantity of high-protein feed for hogs. This would mean about one-third more high-protein feed for hog feeding. A similar increase in the protein in pasture would mean a greater protein intake for cattle even if it did not release much high-protein concentrates for other livestock. 6/

Use of Urea 7/

Another relatively recent development on a commercial scale that from a nutritional standpoint, offers an opportunity for saving high-protein concentrates in cattle and sheep rations is the production of urea. Urea is a synthetic chemical product that does not contain any feed nutrients. It can be utilized only by cattle and other ruminants. If added to a ration that is low in protein but with sufficient starch, the urea is converted into protein by bacteria in the digestive tract of ruminants. The conversion into protein is satisfactory when the urea is fed along with cereal grains but the conversion is poor when it is fed with hay alone. One pound of urea plus 7 pounds of grain will replace about 7 pounds of soybean meal. 8/ It therefore would not pay to feed it when the price of oilmeal is only a little above that of grain. It does not pay to use it when a ration containing sufficient protein is already being fed. In experiments, it has generally been found to be more satisfactory for cattle than for sheep. There is some variation in the results with dairy and beef cattle but, in general, it has been satisfactory when fed in combination with liberal quantities of grain. There apparently must be a considerable supply of easily digestible carbohydrates such as grain, molasses, etc., to enable the bacteria to work. The more fibrous and less digestible carbohydrates, (as straw, hay, corn stover, and corn cobs) are not satisfactory feeds to use with urea unless they are fed along with sufficient, easily digested carbohydrates such as grain or molasses.

6/ If further investigation confirms the recent recommendations of the Bureau of Dairy Industry that the protein content of dairy rations for average farm cows can be safely lowered 3 or 4 percentage points then $\frac{1}{4}$ to $\frac{1}{2}$ million tons of oil meal could be made available for other livestock.

7/ Articles dealing with urea are published in the following:
Journal Dairy Research 9 pp. 263, 25 p 925
Journal of Nutrition 22 p 167 and 183
Animal Science 1 p. 236, 1946 p. 393, 1947 p. 445 and 1948 p. 24
Proceedings American Society of Animal Production 1939, p. 404.

8/ Morrison F.B., Feeds & Feeding, p. 94.

Urea seems to have important possibilities in replacing protein feeds on dairy farms and in cattle feeding. It must be very thoroughly mixed with the grain. The exact conditions under which individual farmers could use urea do not seem to have been determined, as there have been varying results as to palatability, etc. More than 2 3/4 million tons of high-protein concentrates are used by dairy cows in this country probably 70 percent of which is supplied in commercial mixed feeds. Thus it would seem that if a considerable use of urea is to be brought about it will have to come through mixed feeds. Cattle feeders probably use less than one-half million tons of oilmeals. Most of the grain fed to cattle in the feedlot is fed as ear or shelled corn. To use urea it would be necessary to grind the corn and mix in the urea, as it cannot be fed by itself. The other alternative is the purchase of special mixed concentrates which include urea.

Animal-Protein Factor

Good feeding recommendations have heretofore suggested that at least 10 percent of the protein fed to hogs and poultry should be of animal origin, since proteins of plant origin do not contain all the kinds of protein needed for poultry and hogs. Furthermore, the animal-protein supplements furnish mineral and vitamin factors that are not present in adequate quantities in plant-protein concentrates. Protein is a complex substance made up of more than 20 amino acids, which are used in repairing and building body tissues and in the production of eggs and milk. Some of these can be made within the body but others must be provided in the feed. Cattle and sheep can use protein of plant origin but hogs and poultry require some of the high-quality proteins of animal origin. Some alleviation of this requirement seems probable through the use of special products that will supply the needed minerals, vitamins, and amino acids.

The supply of commercial animal proteins consists of tankage and meat scrap (byproducts of the slaughtering and rendering industries), fish meal (a byproduct of the fishing industry), and dried milk products. The production of these is not much larger than before the war. Prices of commercial animal-protein feeds were relatively higher in 1949 than prices of other high-protein concentrates, probably reflecting an increase in demand from more poultry and hogs with no increase in the supply of these feeds. How to obtain increased quantities of the necessary animal-protein feeds is a real problem.

A recent development is the recognition of growth factors contained in such animal proteins as fish meal, meat scraps, and milk, and known as the "animal-protein factor." 9/ One of the identified factors is Vitamin B_{12}. It is required for the growth of young pigs, chickens, and turkeys, and for reproduction in chickens and probably in swine. The addition of the animal-protein factor to the ration permits the oil meals to take the place of a part of the meat scrap, fish meal, and milk products in feeding hogs and poultry. Concentrates of the material are being made by several firms and are available to both feed mixers and individual farmers. The use of these concentrates allows plant protein to be substituted for a part of the animal proteins in rations for hogs and poultry. Therefore in the long run it may cause animal

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9/ Bird, H. R. Animal Protein and Related Factors in Animal Nutrition. Bureau o Animal Industry. A.H.D. 128. December 1949.

proteins to sell at prices more in line with their protein content, compared with other protein feeds and may tend to increase the price of soybean meal since this is probably the feed that will generally be used with the animal-protein factor. The use of the animal-protein factor will not reduce the total quantity of protein needed. Animal-protein feeds will still be needed to supply other factors still unidentified, that are required by poultry and hogs.

IN BRIEF

In brief, four measures are available for increasing the protein content of our feed supply.

(1) Increasing the acreage and yield of good hay and pasture. Yields are improved through the use of improved practices in growing, harvesting, and storage, of hay and grasses, and the increased use of fertilizer, and the timely cutting of hay.

(2) Planting larger acreages of soybeans and other oilseeds. But this involved consideration of oil supplies as well as the need for reducing the acreage of intertilled crops in the interest of soil maintenance. Over a period of years soybean meal probably will continue to increase in use, relative to other protein feeds, because the production of other oil seeds is more dependent on the demand for other products than on the demand for meal.

(3) Expansion of the use of urea. From a physical standpoint it could substitute for a part of the high-protein feeds now being fed to cattle.

(4) Greater use of the animal-protein factor or its components. This has an indirect effect in expanding the use of high-protein feeds in that it will allow plant protein to be substituted for animal proteins of higher price.